forward voltage of a diode selected from the group consisting of a light emitting diode and a laser diode at a constant light power or for balancing the circuit of a diode which is stabilized using a method according to claim 4, the method comprising tracing the time progression of the light power during a power-up procedure and setting the parameters such that the light power remains constant in spite of the increasing temperature of the diode after power up.

ADDITIONAL FEE:

Please charge any insufficiency of fee, or credit any excess, to Deposit Account No. 50-0427.

R E M A R K S

The Office Action issued July 31, 2002 has been received and its contents have been carefully considered.

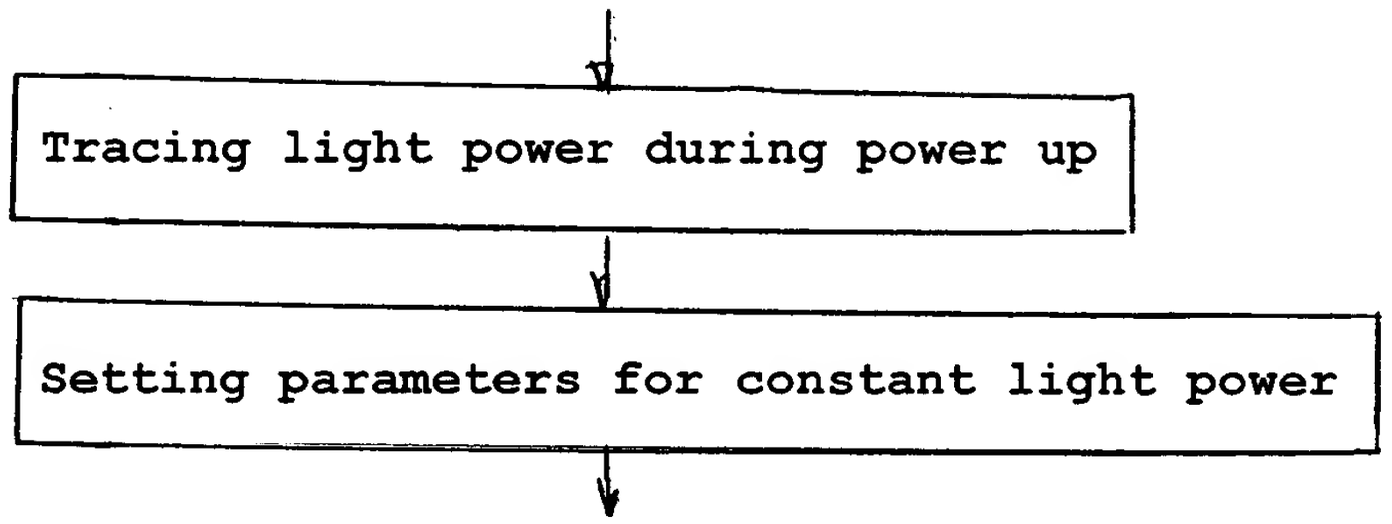
I. Objections under 35 USC §112

Regarding the objection to the drawings, applicants assume that the Examiner refers to the dependent claim 12 which recites the steps of:

"tracing the time progression of the light power during a power up procedure; and

setting the parameters such that the light power remains constant in spite of the increasing temperature of the diode after power up".

Applicants propose to submit a new Fig. 17 showing a flow chart consisting of two boxes as follows:



As the Examiner will understand, the addition of such a flow chart will add little or nothing to the disclosure and understanding of the present invention. Therefore, it is respectfully requested that the Examiner's request for a corrected drawing be withdrawn.

The claims of this application have been thoroughly reviewed and amended, where necessary, to remove certain obvious informalities and to overcome the informalities in claims 7 and 10 kindly noted by the Examiner. It is now believed that all of the claims are clear and definite as required by 35 USC §112.

In addition, claim 1 has been amended to make clear that the measure of the light power emitted by a light

emitting diode or laser diode is derived solely from a combination of the forward current and the forward voltage of the diode...". It is believed that the term "solely" was implied in the original claim language; however, it is now explicit.

All of the claims of this application stand rejected under 35 USC §102 and 35 USC §103 over the U.S. Patent No. 5,392,303 to Shiozawa et al., U.S. Patent No. 4,710,631 to Aotsuka et al. and U.S. Patent No. 4,604,753 to Sawai. These rejections are respectfully traversed for the reasons given below.

II. Claim Rejections under 35 USC §102

a. In General:

The main objective and feature of the present invention is to obtain information about the emitted light power (optical output power) from forward voltage and forward current of the light emitting diode or laser diode. It is unimportant that these quantities also allow for computation of the power consumption (electrical input power) of the diode. This quantity (power consumption) does not contain any useful information about the emitted light power so the computation thereof is irrelevant to the invention.

The main benefit resulting from the invention is that, during operation of the light emitting diode or laser diode, it is not necessary to

(a) measure the emitted light power,

(b) measure any temperature, or

(c) control any temperature;

to achieve stable optical output power.

This does not mean that accomplishment of these three tasks is no longer useful. However, it does mean that the present invention is not anticipated by any system which requires accomplishment of one or more of these tasks during operation of the diode in order to obtain stable optical output power.

It should be noted that claim 1 of this application does not exclude a method where the optical output power is influenced by a variation of the temperature of the diode, instead of a variation of forward current or forward voltage. Even with such a method, however, the present invention is not anticipated by systems which require some means of temperature control.

b. Claims 1, 2, 4-7 and 12:

Shiozawa et al. disclose a method for stabilizing the output frequency of a laser diode by first stabilizing its

output power and then additionally controlling its temperature. Stabilization of the output power is a sub-task of the method which is accomplished by measuring the output power by means of the photodetector 115 whose output signal P is fed (after subtraction of a constant nominal value P0) into a current controller 102 which alone controls the forward current of the laser 101.

The measured forward current and forward voltage of the laser are only involved in the second sub-task of controlling the temperature of the laser in a way that its output frequency is stabilized. They do not contribute to the accomplishment of the first sub-task of stabilizing its output power, which could, in principle, be accomplished by the method recited in the applicants' claim 1, thus eliminating the need for the photodetector 115.

Neither a method of stabilizing the optical output power of a laser diode without any photodetector nor one to do so by measuring forward current and forward voltage can be derived from the disclosure of Shiozawa et al. Shiozawa et al. teach only a method to stabilize the optical output power of a laser which uses a photodetector while also measuring forward current and forward voltage for some independent purpose.

Simply measuring forward voltage and forward current of a light emitting diode or laser diode - even if the result of this measurement were to cause some effect on the diode - is not an anticipation of the present invention of stabilizing the optical output power of the diode by deriving information on the optical output power from these two quantities.

Consequently, it is believed that claims 1, 2, 4-7 and 12, as now amended, are not anticipated by Shiozawa et al.

III. Claim Rejections under 35 USC §103

a. Claim 3:

Since, as stated above, Shiozawa et al. only disclose a conventional method of stabilizing the optical output power of a laser diode by measuring its light output and correcting its deviation from a constant nominal value, the use of A/D and D/A converters to implement this method would still not make obvious the present invention. It is not relevant by what means this measurement and correction are done.

Stated another way, a conventional method based on the direct measurement of the optical output power cannot anticipate the method recited in claim 3, which eliminates

the need for such a measurement, regardless whether an A/D and a D/A converter are used.

The essence of applicants' claim 3 is not in the use of A/D and D/A converters when implementing just any method of optical output power stabilization, but how to establish the functional correlation between forward voltage and forward current that indicates that the optical output power is equal to a nominal value. Doing this by means of an A/D and a D/A converter, and a suitable data processing device in between, perhaps is the most straightforward implementation or embodiment of the present invention. This embodiment becomes possible, once it is known that there is such a functional correlation (claim 1) which can be established solely by electrical means (claim 2). This embodiment cannot be derived from any of the cited prior art references, nor can the knowledge that this functional correlation can easily be established using an A/D and a D/A converter be taken from Aotsuka et al. because no such functional correlation is mentioned there.

Therefore, applicants' respectfully request that the rejection of claim 3, as being unpatentable over Shiozawa et al. in view of Aotsuka et al., be withdrawn.

b. Claims 8-10:

Since, as explained above, the stabilization of one light emitting diode or laser diode according to the method of the present invention is not anticipated by Shiozawa et al., the subject matter as set forth in claims 8-10 can also not be derived from Shiozawa et al., by mere duplication of the essential working elements. Therefore, claims 8-10 are believed to be patentable over Shiozawa et al. as well.

It should further be noted that the invention set forth in claims 8-10 cannot be considered to be derived from the subject matter of the previous claims by mere duplication of the working elements. If a light emitting diode or laser diode is to be stabilized, the essential working elements include not only the diode itself but also the parts required to obtain this stabilization. If several diodes are to be stabilized, the simple duplication of the working elements would mean duplication of all these parts, not only the diodes. In the case of Shiozawa et al. this would mean that output power stabilization of a certain number of lasers would also require the same number of photodetectors and the same number of current controllers.

Another way to duplicate stabilized light emitting diodes or laser diodes is to connect several diodes in a cluster and then to apply the measures necessary to obtain

stabilization to that cluster. However, laser diodes as well as light emitting diodes cause certain difficulties when several of them are connected to each other, even if there is no need for stabilization.

A good example is the use of LED's for traffic lights. For one unit there are about 100 single LED's required which must all have the same brightness, and this brightness must not change with variations in temperature. One could imagine connecting all the LED's together and treating them as one light source. If they were connected in series, failure of one LED would cause failure of the whole unit, so this would not be acceptable. Connecting them in parallel would cause large variations in brightness, because diodes vary slightly in forward voltage at a given current, and supplying them all with the same voltage would cause large variations in current. Connecting a resistor in series with each diode would give better uniformity because then the current would also be determined by the voltage drop in the resistor. The greater the voltage at the resistor in comparison with the forward voltage at the diode, the smaller the influence of variations of the forward current, but the more power would also be wasted by heating the resistor.

These difficulties that arise from measures which can be called "mere duplication of elements" have not been explicitly outlined in the description of the present invention because they are common difficulties of simply operating a multitude of LED's, and not of stabilizing their optical output.

Claims 8-10 are related to methods of operating a plurality of light emitting diodes or laser diodes with stabilized optical output by applying the measures necessary for stabilization as set forth in the preceding claims to only one of them, and transferring the changes of the electrical input quantities which compensate the influence of temperature to the others. This is quite different from applying said measures once to all of the diodes which could be called mere duplication of elements but would fail for the reasons explained above.

Consequently, the invention recited in claims 8-10 does not result from the mere duplication of elements, nor from the teaching of Shiozawa et al.

c. Claim 11:

It is indeed well-known that the forward voltage of any diode varies with temperature if its forward current is kept constant. Sawai does not explicitly mention the constancy

of the forward current in column 2, lines 59-66, because the forward voltage is, of course, first a function of the forward current and its being constant must be implied in order to only speak of the effect of some other quantity on the forward voltage. However, Sawai does imply that the forward current is to be held constant. The constant current source used by Sawai to operate the diode as a temperature sensing device is labeled C1 in Fig. 3 and Fig. 5.

In fact, simple silicon diodes sold as rectifiers are used as temperature sensors in low-cost electronic thermometers, and it is indeed very common to measure their forward voltage changing with temperature when operated with a constant current.

Applicants' claim 11 recites the measurement of <u>both forward voltage and forward current</u> at different temperatures. The <u>forward current is not kept constant</u> in this case. Its value can also change with temperature because it is determined, by requiring that there be always the same optical output power (which only exists with light emitting diodes and lasers diodes), at all of these temperatures. Nevertheless, there may also be cases where the forward voltage does not change at all with temperature

when the optical output power is kept constant. What is important is that a measurement of this type only makes sense in conjunction with the present invention.

Therefore, it is believed that claim 11, distinguishes patentably over Sawai.

Since all of the claims of this application have been amended so as to render them clear and definite under 35 USC §112, and since the claims distinguish patentably over the cited prior art for the reasons given above, this application is believed to be in condition for immediate allowance. A formal Notice of Allowance is accordingly respectfully solicited.

Respectfully submitted,

By _____
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I hereby certify that this correspondence is being deposited with the United States Postal Services as first class mail in an envelope addressed to: Commissioner of Patents and Trademarks, Washington, D.C. 20231 on 10-31-02

MILDE & HOFFBERG, LLP

By _____

Date 10-31-02

VERSION TO SHOW MARKINGS OF CHANGES MADE

IN THE CLAIMS:

Please amend claims 1-12 to read as follows:

1. (Thrice Amended) In a method for stabilizing the optical output power (light power) of a diode selected from the group consisting of a light emitting diode and a laser diode, the improvement comprising the step of deriving a measure for the light power emitted by the diode from solely a combination of the forward current and forward voltage of the diode, based on the assumption that at a constant light power the forward voltage is a function of the forward current.

2. (Twice Amended) The method as set forth in claim 1, wherein the function that determines the forward voltage from the [diode] forward current of the diode at a constant light power is determined through measurements at various temperatures and wherein the diode is connected such that the resultant functional correlation between [diode] forward current and forward voltage is set solely through electrical [mechanisms] means.

3. (Twice Amended) The method as set forth in claim 2, [where] wherein the forward voltage is measured via an analog/digital interface using a suitable data processing device, and [where] wherein the [diode] forward current is controlled via a digital/analog interface such that the previously determined functional correlation is established between the set [diode] forward current and the measured forward voltage.

4. (Twice Amended) The method as set forth in claim 2, wherein it is presumed that the function, from which at a constant light power the forward voltage is determined from the [diode] forward current, is linear.

5. (Thrice Amended) The method as set forth in claim 4, wherein, in the case of a constant forward voltage at a constant light power and an increasing [diode] forward current, this correlation is established by directly connecting the diode to a constant voltage source.

6. (Twice Amended) The method as set forth in claim 4, wherein, in the case of a linearly decreasing forward voltage at a constant light power and an increasing [diode]

forward current, this correlation is established through the operation of the diode together with a resistor connected in series with a constant voltage source.

7. (Twice Amended) The method as set forth in claim 4, wherein, in the case of a linearly increasing forward voltage at a constant light power and an increasing [diode] forward current, this correlation is established [through the operation of the] by directly connecting the diode [in] to a [suitable] circuit [with a negative resistance whose reference input is connected with] which exhibits the behavior of a constant voltage source connected in series with a resistor of negative resistance.

8. (Twice Amended) A method for stabilizing [several] a plurality of similar light emitting diodes or laser diodes, wherein [one] a first diode is stabilized using the method set forth in claim 3, and wherein the remaining diodes are connected in series and operated such that the current flowing through the first [light emitting diode or laser] diode also flows through the remaining ones.

9. (Twice Amended) A method for stabilizing [several] a plurality of similar light emitting diodes or laser diodes, wherein [one] a first diode is stabilized using the method set forth in claim 3, and [where] wherein the remaining [light emitting diodes or laser] diodes are operated by one or more voltage sources whose source voltage follows the forward voltage of the first [light emitting diode or laser] diode.

10. (Twice Amended) A method for stabilizing [several] a plurality of similar light emitting diodes or laser diodes, wherein [one] a first diode is stabilized using the method set forth in claim 3, a first portion of the remaining diodes is connected in series and operated such that current flowing through [the] said first diode also flows through the [remaining ones of this] first portion of the remaining diodes, a second portion of one or more of the remaining diodes is operated by [one or more voltage sources] connecting each to a voltage source whose [source] voltage follows the forward voltage of the first diode and wherein one or more additional portions of the [diode] remaining diodes are connected in series and operated such that the

currents flowing through the diodes of the second portion flow also through the diodes of the additional portions.

11. (Thrice Amended) A method for determining the forward voltage of a diode, selected from the group consisting of a light emitting diode and a laser diode, as a function of the diode current at a constant light power, comprising the steps of: varying the temperature of the diode using a heating or cooling device; determining the emitted light power by means of a photodetector; and maintaining the emitted light power at a constant level by means of a control device and [wherein] measuring the values of the forward voltage and the [diode] forward current of the diode [are measured] at various temperatures.

12. (Twice Amended) A method for determining the parameters of a linear correlation between the [diode] forward current and the forward voltage of a diode selected from the group consisting of a light emitting diode [or] and a laser diode at a constant light power or for balancing the circuit of a [light emitting diode or laser] diode which is stabilized using a method according to claim [5] 4, the method comprising tracing the time progression of the light power

during a power-up procedure and setting the parameters such that the light power remains constant in spite of the increasing temperature of the diode after power up.